Amendments to Specification

[0001] This invention relates to electroless nickel plating process and more particularly to a method to achieve continuous hydrogen saturation in sparingly used electroless ~~electoless~~ nickel plating processes.

[0014] Step 107: Immersing the wafer in a catalytic metal chloride solution, such as palladium chloride, for about 60 to 180 seconds "activates" the copper surface, i.e., a thin layer of seed metal (such as palladium) is deposited onto the clean, non-oxidized copper surface.

[0018] Step 111: Electroless plating of outermost layer, which is bondable and simultaneously provides a barrier against up-diffusion of the underlying barrier metal. If gold or palladium is selected, plating between 10 to 20 minutes will deposit about 0.1 to 0.2 um of palladium and 40 to 80 nm Au, respectively. The palladium process is an electroless process that plates at the rate of about .01 um per minute. The gold process is an immersion process that is self limiting at about 0.08 um at 8 to 12 minutes. A preferred process uses first an electroless palladium process for between 8 and 22 minutes to deposit 0.1 and 0.3 [[:]]µm of palladium followed by an immersion gold plating process step with self-limiting surface metal replacement. If gold is selected, plating between 400 and 800 seconds will deposit approximately 40-80 nm of gold. As a second step for thicker metal layer (0.5 to l.5 µm thick), the immersion process is followed by an autocatalytic process step.

[0026] ~~Figure 3 illustrates a block diagram~~ Figure 3A illustrates Steps 1 and 2 and Figure 3B illustrates Step 3 of the process flow for fabricating the bond pad cap according to the present invention.

[0030] The plating process involves a series of tanks where the wafer or lot of wafers are put into and taken out of the tanks. In accordance with a preferred embodiment of the present invention illustrated in [[Fig. 3]] Figs. 3A and 3B, the first Step 1 is to place a nickel plating bath into a state of hydrogen saturation by processing 1-4 wafers coated entirely on one side with copper metal. The step 1 process consists of the steps of Step 301 starting with nickel starting material (blanket copper wafers), Step 302 of pre-clean, Step 303 rinse, Step 304 activate, Step 305 rinse, Step 306 of applying a conditioner, Step 307 of rinse, Step 308 of electroless nickel plate for 15 to 30 minutes, Step 309 of rinse and Step 310 of spin dry. The steps of rinsing, pre-cleaning activating, conditioning are like that described above and to follow in the specification.

[0033] The production wafer process of Step 3 may be like that in Steps 319 through 333 in Figure 3 after the initial start up of in Step 1 of Steps 301 through 310 of placing the nickel plating tank into hydrogen saturation and the Step 2 of plating specimen in the tank to maintain hydrogen saturation with steps 311 through 318. The wafer process Step 3 begins Step 319 [[od]] of providing production wafers Step 319, a pre-clean Step 320 using Duraprep BP 54 for 90 seconds at 43 degrees C. This is a surface conditioner. The pre-clean process cleans the wafers to remove the oxide. At the next Step 321 is a quick dump rinse with DI water for 110 seconds at 23 degrees C. After this is a surface activation Step 322 where a single atom layer of palladium is placed on the copper so it can have an active surface so the nickel will plate onto that surface. This activation step uses, for example, Ronamrse Catalyst CF for 120 seconds at 30 degrees C. The surface is activated by a palladium layer. This palladium Step 322 creates energy on the surface that will attract the nickel. This takes 90-120 seconds. The next Step 323 is a rinse. The Step 324 applies a conditioner such as Ronamerse BP conditioner for 60 seconds at 23 degrees C to remove ionic Pd. After this in Step 325 is another quick dump rinse. The next step 326 is to place the wafers into the prepared nickel bath or tank using for example Everon BP wherein the bath is in hydrogen saturation (because of Steps 302

through 318) for 120 seconds at 85 degrees C. The nickel plating is 0.3 – 0.5 μm thick. This is followed by two quick dump rinses (Step 327 of DI water with each for 90 seconds at 23 degrees C). The next Step 328 is to palladium plate using Pallamerse BP for 720 seconds at 65 degrees C to put on a 0.2 μm thick layer. The next Step 329 is a quick dump rinse of DI water for 110 seconds at 60 degrees C. The next Step 330 is immersion in a gold tank using Aurolectroless BP for 720 seconds at 85 degrees C to put on a layer of 800 Angstroms gold for good adhesion to the gold balls on the end of the gold bond wires. This is followed by another quick dump rinse (Step 331) of DI water for 110 seconds at 60 degrees C. The wafers are then spin dried in Step 332. For more wafers (Step 333) repeat Steps 319 through 333 keeping the metal specimen such as copper in the nickel plating tank.

[0035] The wire bonding process begins by positioning both the IC chip with the bond pads and the object, to which the chip is to be bonded, on a heated pedestal to raise their temperature to between 100 and 250 degrees C. Referring to Figure 4 a wire 210 typically of gold, gold-beryllium alloy, other gold alloy having a diameter ranging from 18 to 33 [[:]]μm is threaded through a capillary. At the tip of the wire extending from the capillary, a free air ball 211 is created using a flame or a spark technique. The ball 211 has a typical diameter from about 1.2 to 1.6 wire diameters. The capillary is moved towards the chip bonding pad at layer 207. A combination of compression force, heat and ultrasonic energy creates the formation of a strong metallurgical bond by metal interdiffusion. At time of bonding, the temperature usually ranges from 100-250 degrees C.